BROOKHAVEN NATIONAL LABORATORY
NATIONAL SYNCHROTRON LIGHT SOURCE
SOURCE DEVELOPMENT LABORATORY

MEMORANDUM

DATE: 14 April 1997

TO: Tom Sperry, SEP

FROM: Erik D. Johnson, NSLS EDJ

SUBJECT: **Request for SDL NEPA Determination**

This memo is to follow up on the discussion Nick Gmür and I had with you this morning regarding the NEPA requirements for the Source Development Laboratory (SDL). The previous documentation we are using as our point of departure is the NEPA review (February 1992) and FONSI (2 July 1992) issued for the XLS storage ring. In this memo, I will outline the differences between the existing documentation and the facility we currently envision. We are seeking your guidance regarding our next steps in the process. To help in your evaluation, I highlight below the differences between the XLS and SDL projects. For additional information regarding the SDL experiment goals and parameters, please refer to the paper attached to our SDL Project Planning meeting notice (6 March 1997) which was copied to you at the time of posting. Please contact either myself or Nick Gmür if you need additional information.

Project Description:
The original XLS program was for a small superconducting magnet storage ring to be operated at 700 MeV within building 729 (which was not yet built when the NEPA document was written). To inject into the storage ring a 200 MeV linac was to be constructed as the electron source. Between 1992 and now, the building was built, linac installed and tested, and the XLS project canceled. The linac testing phase of the program was known as ELF (Electron Linac Facility), and had a PSAR developed describing its operating envelope. There is also a considerable body of experience regarding this linac and its operation in building 729.

We have since undertaken a new line of research which groups several experiments under the same project heading known as the Source Development Laboratory (SDL). They are all built around the same linac fitted with a photocathode gun of the type developed at the BNL ATF and used both at the ATF and the Chemistry Department CRCR facility. The linac can be used for experiments by itself, or as the injector for either a small storage ring or free electron laser. To house these changes, building 729 was expanded an additional 40 feet (to the east toward the tank farm), a 2 ton overhead crane was added, and a class 1000 clean room was added to house the laser system required for the new program. This laser system is comprised of three class IV YAG lasers to drive an titanium:sapphire laser.

All of the laser components are commercial units, used in their 'off the shelf' configuration. This laser is in fact largely copied from the system currently in use for the CRCR gun laser. While the laser system itself is a 'bench top' standard system, the optics for beam transport (laser room to gun) and pulse shaping (modify pulse length or time/energy distribution) are being specifically developed by us for our application. All beams are enclosed in interlocked spaces accessed only by qualified personnel.

The actual sequence of operations now envisioned is as follows:

Activity	Approximate Time frame
Commissioning of the Laser System	June 1997
Assembly and Testing of Linac in stand alone mode	December 1997
First FEL experiments (UP-FEL)	July 1998
Storage Ring Operations (CSRE)	2000 at earliest

The experimental programs do not preclude each other, although they will not run simultaneously in real time; that is linac experiments may be conducted at any time after the linac is constructed. The selection of either the Ultraviolet Project Free Electron Laser (UP-FEL) or Coherent Synchrotron Radiation Experiment (CSRE) part of the accelerator plant is made by the powering of a dipole magnet (once both experiments have been built). From our present understanding, the CSRE experiment is the longest lead prospect because a high frequency RF system (most probably superconducting at 2856 MHz) must be developed. This is by no means a certainty from the standpoint of program funding.

The following table provides some comparisons between the elements of the XLS project as described in the NEPA document, and the SDL project.

Item	**XLS**	**SDL**	**Units**
Linac			
Nominal Rated Energy	200	200	MeV
Electron Gun Type	Electrostatic	Photocathode	
Electron Gun Energy	0.12	5	MeV
Repetition Rate	10	10	Hz
Maximum Current at 200 MeV	50	20	nA
Maximum Current at 5 MeV	-	100	nA
Pulse Compression Energy	-	84	MeV
Compression Ratio	-	12	
Nominal Pulse Length	10 ns	10 ps	
Laser System			
10 Hz Nd:YAG GCR 150 (Class IV @ 1μm)	-	650	mJ
10 Hz Nd:YAG GCR 170 (Class IV @ 1μm)	-	850	mJ
CW Millenia YAG laser (Class IV @ 1μm)	-	5	W
Storage Ring			
Ring Energy	700	200	MeV
Stored Current	1000	>1	mA
RF Frequency	211	2856	MHz
FEL			
Wavelength Range	-	1000-100	nm
Pulse Energy	-	>1	mJ
Pulse Repetition Rate	-	10	Hz
Pulse Duration	-	20-0.01	ps

Xc: N. Gmür